DOCUMENT RESUME

ED 148 638 SE 023 790

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TITLE	Five Years of Evaluating Federal Programs--Implications for the Future. Research Paper No. 22.
INSTITUTION	Minnesota Univ., Minneapolis. Coll. of Education.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	Apr 76
GRANT	NSF-GW-6800
NOTE	26p.; For related documents, see SE 023 784-792
EDRS PRICE	MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS	Curriculum Planning; *Educational Planning; Educational Research; *Federal Programs; *Needs Assessment; *School Administration; *Science Education; Secondary Education; Secondary School Science; *Teachers
IDENTIFIERS	Minnesota Research and Evaluation Project; National Science Foundation; *Research Reports

ABSTRACT

This study reports the results of several needs assessment procedures used with teachers and principals from a random sample of 224 schools involved in the Minnesota Research and Evaluation Project during the 1971-1975 period. Data were gathered using questionnaires, goal ranking procedures, and a Curriculum Attitude Survey. Principals and teachers had somewhat different points of view on science education and the functions of secondary education. However, both groups included student self-development, basic skills, and decision making as the top three functions of secondary education during the next decade. Principals ranked instruction preparation, curriculum development, and information as the top three areas for improvement. Teachers strongly endorsed the concept of teacher institutes and curriculum development but were less supportive of the dissemination of new science curricula. (Author/BC)

minnesota research & evaluation project

college of education university of minnesota

funded by the national science foundation

RESEARCH PAPER #22

Five Years of Evaluating Federal Programs--Implications for the Future

Wayne W. Welch

April 1976

This study was supported by Grant GW-6800 from the National Science Foundation to the University of Minnesota; Wayne W. Welch, Project Director.

Five Years of Evaluating Federal Programs—
Implications for the Future *

Wayne W. Welch
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Background

The Minnesota Research and Evaluation Project (MREP) is a group of science and mathematics educators and educational psychologists at the University of Minnesota. We have been funded by the National Science Foundation (NSF) the past five years to conduct a number of studies related to curriculum implementation, teacher preparation and, most recently, assessment of needs.

The Project was initiated in 1971 to evaluate the newly funded Comprehensive Teacher Training Program. To my knowledge, this was the first time NSF funded an evaluation project at the same time it started a new program. The Comprehensive Program was designed:

1. To help schools, through the education of their instructional, resource and supervisory personnel, in developing their capacity for self-improvement in science and mathematics education, and

2. To assist the efforts of colleges and universities in developing as part of their regular activities more effective programs for the pre-service and in-service education of science and mathematics teachers.

Total budget for the program was over two million dollars which was distributed to five experimental projects designed to impact schools in five geographic regions.

*Revision of a paper presented for a symposium at the National Association for Research in Science Teaching (NARST) annual meeting in San Francisco, April 23-25, 1976.

The evaluation design was a quasi-experimental design using pre- and post-test information from approximately 330 experimental and 220 comparison schools. The experimental schools are those in the five geographic regions, while the control schools are in adjacent regions (Welch and Gullickson, 1973). Information gathered during the pre-test in 1972 was also used to provide needs assessment information to project directors. Post-testing was carried out in 1976. During the interim three years (1972-75) the pre-test data were used in a number of research studies, and several evaluation projects were carried out by Project staff.

An unexpected perturbation on our evaluation plan was the changing nature of NSF pre-college programs during the past five years. A history of these changes and the concomitant MREP activities are shown in Figure 1.

In spite of changing NSF program thrusts--a five-year sequence from comprehensives to implementation to needs assessment to research--one important factor remained. The geographic impact regions with their attendant schools are essentially the same today as they were in 1971. This has made two things possible: First, the MREP evaluation plan could be carried out as it was originally designed. Second, there is a fixed set of schools (students and teachers) which could be targets for different NSF activities. Because of this, contacts have been maintained with these schools the past five years and considerable amounts of data have been gathered from administrators, teachers, and students.[1] Studies generated from these data form the basis for the problem of this paper: what has been learned that may have implications for future funding of pre-college science education activities?

[1]Nearly 1.5 x 10^6 bits of information are stored on our computer tapes. An equal amount is currently being gathered during the post-test.

FIGURE 1

NSF Programs and MREP Evaluation

Year	NSF Funding Decisions	Major MREP Activities
1971-72	Initiate Comprehensive Program	Pre-testing Project needs assessment
1972-73	Terminate Comprehensive Program	Portal School evaluation Summarize pre-test data Science/mathematics education research
1973-74	Initiate Implementation Program	Evaluate implementation projects Science/mathematics education research
1974-75	Terminate Implementation Program	Cost analysis Persistence of implementation Evaluation guidelines Study implementation process
1975-76	Support Needs Assessment	Post-testing NSF needs assessment
1976-77	Support Science Education Research	Final report Science/mathematics education research

Needs Assessment

The activities most relevant to the topic of this paper--assessment for future direction--were carried out in 1976. Several needs assessment procedures were developed and implemented at a series of 14 regional meetings attended by representatives from a random sample of 224 schools from 13 western and midwestern states.[2] Because the data were recently collected (March 1976) only preliminary results are currently available.

Data were gathered from teachers and principals using questionnaires, goal ranking procedures, and a Curriculum Attitude Survey (CAS). In addition, small group discussions and interaction with NSF staff members were part of the needs assessment procedures.

Principals

Principals were asked to rank five different areas of need; these areas included: (1) curriculum materials, (2) instructor preparation, (3) ancillary support, (4) innovative projects, (5) information. Also, within each area, principals ranked various needs and indicated whether the local district, state, or federal government was responsible for achieving those needs. Table 1 is a summary of results.

Clearly, principals see teacher training as the major need, followed by curriculum development. The generation and dissemination of information was ranked third.

A ranking of needs within each of the top three areas is presented in Table 2. The need labels are abbreviated. A complete listing is found in Appendix A. Perceived responsibility (district, state, federal) also is shown by the percentage of principals marking who they felt should attend to improving a given need.

[2]The states included in the sample were California, Colorado, Idaho, Indiana, Iowa, Michigan, Minnesota, Mississippi, Montana, Nebraska, South Dakota, Utah, and Wyoming.

TABLE 1

Principals Ranking of Science Need Areas

Area of Need	Mean Rank*	S.D.
Instructor Preparation	1.75	1.10
Curriculum Development	2.31	1.15
Information	3.31	1.25
Innovative Projects	3.59	1.24
Ancillary Support	3.79	1.11

*Code: 1 = greatest need
2 = 2nd greatest need
etc.

TABLE 2

Principals Ranking of
Needs in Three Areas

Area	Rank	Needs	Responsibility (%) Local	State	Federal
Instructor Preparation	1	In-service methods	81	63	32
	2	Pre-service methods	32	92	35
	3	In-service subject matter	70	65	37
	4	Pre-service subject matter	29	93	32
Curriculum Development	1	Total curricula -- slower students	72	70	48
	2	Total curricula -- better students	61	67	38
	3	Curricula modules -- slower students	76	62	45
	4	Curricula modules -- better students	67	64	46
Information	1	Dissemination -- pedagogy	40	85	54
	2	Dissemination -- curricula	42	79	57
	3	Research -- pedagogy	24	71	78
	4	Research -- science learning	24	68	81

According to this sample of principals, the desired role of federal agencies in science education is clear. First, they must work with states and local districts to improve teachers, particularly teaching methods. Secondly, again in cooperation with states and local districts, they must work to develop better curricula, especially for lower achieving students; and, thirdly, in collaboration with the states, support research on teaching and learning as well as disseminating existing information on teaching and curriculum alternatives.

Parenthetically, it might be added here that the discussion thus far has focused only on perceived needs, not on the means by which these needs might be achieved. Completing the process will require describing what is currently being done and identifying those programs that appropriate agencies might initiate. For example, this assessment provides support for NIE to continue (perhaps expand) the ERIC system in science and mathematics (Dissemination). Also, NSF is given strong support for its recently authorized science education research program (Information).

A second needs assessment procedure involved teachers and principals. Each group was asked to rank ten proposed functions of secondary education (a copy of the questionnaire is found in Appendix B). Our purpose was to assess perceptions of the proper emphasis for secondary education during the next decade.

Respondents were asked to rate the importance of each function on a five-point scale (5 = very important, a must; 1 = should not be a concern of the school). They were also asked to indicate how they felt each function was currently being met in their school (3 = well met; 2 = adequately met; 1 = poorly met).

A common definition of a need is a discrepancy between what is and what should be. Applying that definition to the results in Table 3, would identify needs for large discrepancies between importance and current performance.

Principals' ratings were transformed to T scores (mean of 50 and standard deviation of 10) to simplify the ratings and to show the differences between importance ratings and current performance. This difference permits listing the needs in a priority order. These results are shown in Table 3.

It seems reasonable from Table 3 that during the next decade principals see a major emphasis of secondary schools on developing the self-realization and acceptance (self-esteem) of students and providing them with information processing and decision making skills. Basic skills and improving human relations are important but to a lesser degree. Although the list represents functions for secondary schools, the principals did indicate functions #1 self-esteem and #10 decision making as the major foci for science education. It is interesting to note that the more practical emphases (e.g., health education) did not surface as high need areas.

Teachers

A similar procedure was used with science teachers attending the series of regional meetings described earlier. Although 224 schools were represented at the meetings, about 80 were mathematics teachers. A sample of 135 science teachers responded to the same questions as the principals. Results of their perceptions for ten proposed functions of secondary schools are presented in Table 4.

TABLE 3

Perceived Needs--Secondary Education
Principals

Rank	Function#	Importance*	Current Performance*	Difference
1	Providing for student self-realization and self-acceptance (1)	76	49	27
2	Providing students with information processing and decision making skills (10)	67	44	23
3	Providing for student mastery of basic skills in using words and numbers (3)	76	61	15
4	Human (interpersonal) relations education (2)	53	40	13
5	Citizenship education (4)	51	46	5
6	Vocational education including pre-college counseling (8)	38	46	-8
7	Training in practical skills (e.g., money management, driving) (5)	35	46	-11
8	Health education (physical and emotional) (6)	32	50	-18
9	Providing opportunities for student creativity (7)	24	43	-19
10	General education (sciences, arts, humanities) (9)	46	75	-29
	Mean Ratings	4.08	1.81	

*Expressed as T scores

#Numbers in ( ) refer to the number on the original questionnaire

TABLE 4

Perceived Needs--Secondary Education
Science Teachers

Rank	Function#	Importance*	Current Performance*	Difference
1	Providing for student mastery of basic skills in using words and numbers (3)	79	37	42
2	Providing students with information processing and decision making skills (10)	62	42	20
3	Providing for student self-realization and self-acceptance (1)	62	57	5
4	Vocational education including pre-college counseling (8)	46	46	0
5	Citizenship education (4)	40	45	-5
6	Providing opportunities for student creativity (7)	38	44	-6
7	General education (sciences, arts, humanities) (9)	65	72	-7
8	Training in practical skills (e.g., money management, driving) (5)	39	49	-10
9	Human (interpersonal) relations education (2)	31	47	-16
10	Health education (physical and emotional) (6)	36	61	-25
	Mean Ratings	3.99	1.90	

*Expressed as T scores

#Numbers in ( ) refer to the number on the original questionnaire.

Following a pattern we've found in five years of analyzing data, we note a different ordering of functions by science teachers and principals. Not only do they rank basic skills as the most important function of schools, they also rank current performance in this area at the bottom. Thus, the discrepancy between what should be and what is ($T_I - T_P = 42$) is far greater than any other differential. Information processing and decision making is rated by the teachers as the second greatest need area.

To better quantify the perceptual differences of teachers and principals, a Spearman rank-order coefficient was calculated. A ρ of .64 was obtained, significant at the $p < .05$ level. This suggests a moderate degree of agreement between principals and teachers on their perceptions of these needs during the next decade. Their perceptions of current performance were quite different from principals, $\rho = .35$ (e.g., note functions #2 and #3). However, it is important to note that three functions from this set--self-esteem, basic skills, and decision making--surfaced as the top three needs by both groups (see Tables 3 and 4).

Another phase of the needs assessment study requested teachers' opinions on several programs the National Science Foundation might support in science education. A random sample of 136 teachers was asked to agree or disagree with a series of statements on curriculum development, dissemination, teacher institutes, and the national image of science. Responses to these questions are presented in Table 5.

It seems apparent from Table 5 that teachers strongly support a rebirth of the teacher institute program and see continued need for federally supported curriculum development. Responses to Items 2 and 5

TABLE 5

National Policy for Science Education
Teacher Opinions

Statement	Percentage* Agree	Disagree
The public image of science has dropped considerably in recent years.	60	40
The decline in science test scores on national tests (e.g., National Assessment) is probably due to the increased use of the newer alphabet curricula (e.g., PSSC, BSCS, etc.).	16	84
The federal government should direct more attention toward dissemination of new science curricula.	57	43
A few years ago, the National Science Foundation supported teacher institutes at colleges and universities; this program should be reinstated.	97	3
During the next ten years, federally supported curriculum development in science is probably unnecessary.	13	87

*Based on a random sample of 136 science teachers.

support this conclusion. (This finding is particularly important given recent Congressional pressure against curriculum development.) They are more cautious about the role of the federal government in curriculum dissemination, although a majority support this view. Improvement in the public image of science appears to demand some attention, but it does not cry out for action like the other programs.

Previous Findings

As mentioned earlier, a five-year data base of the Minnesota Research and Evaluation Project has permitted the completion of a number of studies that seem to have implications for future directions in science education, the theme of this paper. A number of the more relevant findings are listed below in executive summary format. The interested reader may pursue the finding further in the appropriate reference.

- Participation in NSF supported institutes was found to be a significant factor in student achievement for senior high school teachers but not for junior high teachers. (Willson and Garibaldi, 1974)

- Principals possess a more positive view of teaching conditions (facilities, curriculum materials, teaching load) than do teachers. (Reineke and Welch, 1975)

- Science teachers are generally satisfied with their own abilities, but they believe their school conditions need improvement. (Lawrenz, 1974)

- Selected teacher characteristics (e.g., process knowledge) account for about one-fourth of the total variance in student outcomes in high school science courses. (Lawrenz, 1975)

- Average cost of training for curriculum implementation is approximately $8 per teacher participation hour. Expected usage rate in the first year following training is about 70%. (Welch and Willson, 1975)

- The NSF Teacher Institute Program appears in general to have been successful in making a significant, positive impact on science education. (Helgeson, 1974)

- Persistence of innovation (i.e., percentage of adoptors who use a curriculum a second year) is less than anticipated. Four separate studies suggest about one-third of new users drop a new program after the first year. (Welch and Ward, 1975)

- Adoption rates and length of usage are higher for elementary teachers who have attended NSF funded implementation sessions than for a corresponding control group. Adoption rate was 66% experimental, 25% control. Length of usage was 50% higher in experimental schools. (Willson, 1975)

- Students' perceptions of the social environment for learning are different for biology, chemistry, and physics classes. Greatest differences usually between biology and physics with chemistry somewhere in between. (Lawrenz, June 1974)

Combining the above research findings with the needs assessment results reported earlier gives us some indication of future directions for science education.

Summary and Conclusions

This study has reported the results of several needs assessment procedures used with teachers and principals from a random sample of 224 schools scattered across the western two-thirds of the United States. In addition, several findings based on data gathered in these schools the past five years have been summarized. Several general findings seem supported by the results.

Principals and teachers have somewhat different points of view on science teaching conditions and functions of secondary education. However, both groups included student self-development, basic skills, and decision making as the top three functions of secondary education during the next decade.

Principals ranked instructor preparation, curriculum development, and information as the top three areas for improvement. Strongest emphasis within each area was given, respectively, to methods training, curricula for lower achieving students, and dissemination of information on teaching strategies.

Teachers strongly endorsed the concept of teacher institutes and curriculum development but were less supportive of the dissemination of new science curricula. This latter opinion is somewhat surprising given the failure of curriculum adoptions to persistence.

Considering that teacher characteristics appear to be related to student outcomes and that institute attendance appears to be related to student change, the findings of this paper might be structured in the following way. The focus of the science education effort is the student. In the decade ahead, we need to concentrate on developing greater self-esteem, decision making ability, and basic skills. The facilitative procedures judged appropriate to accomplish these needs include better teachers, effective curricula, and knowledge available as needed. Several programs which appear effective in achieving these goals should be initiated. These include teacher institutes, curriculum renewal, and research and its dissemination.

A schematic portrayal of these relationships is shown in Figure 2.

FIGURE 2

Implications for Future Direction
MREP Needs Assessment

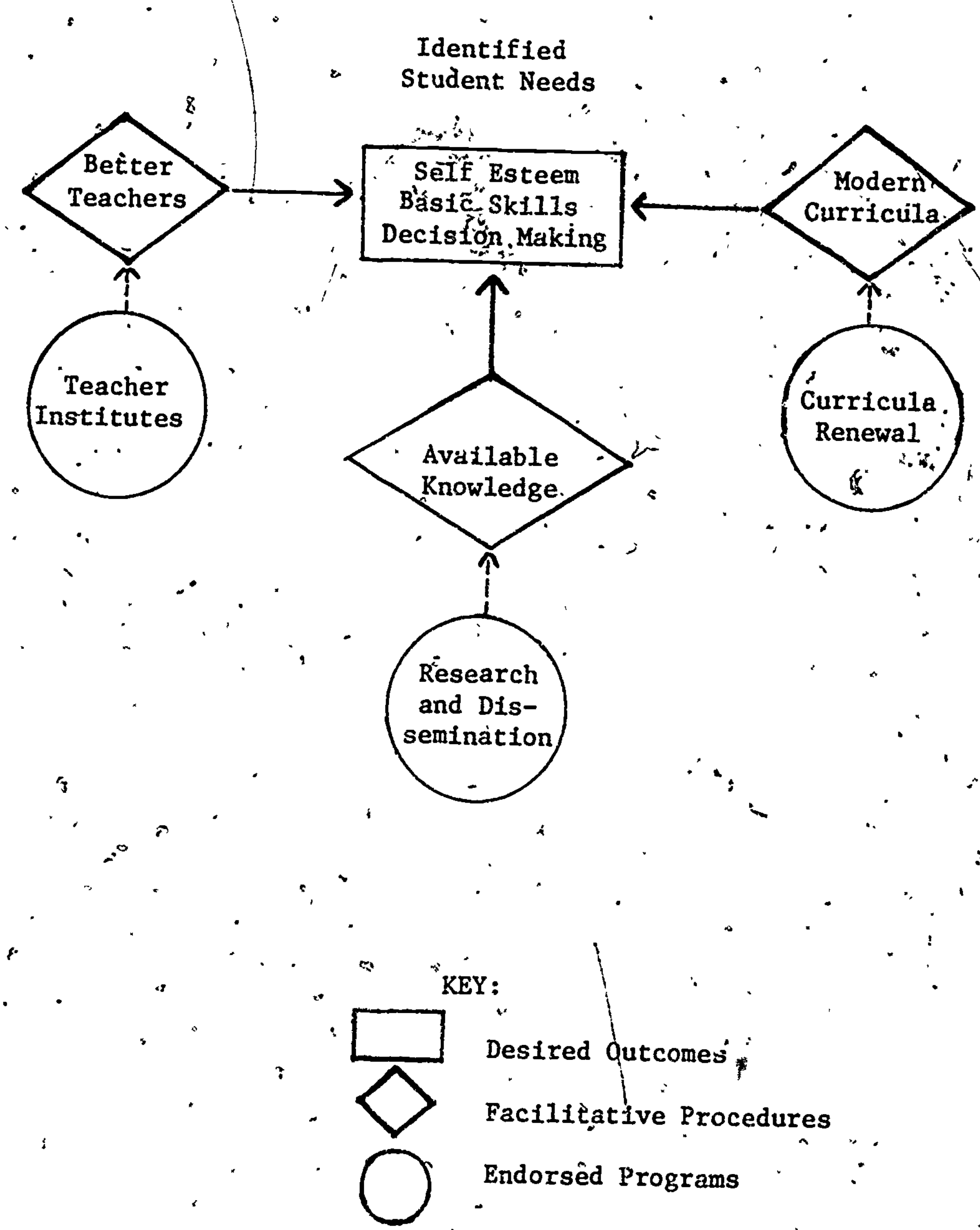

Figure 2 graphically illustrates many of the findings reported in this paper. It is a way of showing the relationship between needed outcomes, procedures, and programs. A plan of action designed to attend to these perceived needs should help us move toward our common goal of effective science education.

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Appendix A

RANKING OF NEEDS

Appendix B

A PRINCIPAL'S PERSPECTIVE

SCHOOL ____________________

IDENTIFICATION NO. ____________

Ranking of Needs Within Each Area

Rank		Responsibility: Local District	State	Federal Agency
	AREA I: CURRICULUM MATERIALS			
____	Better total curricula (like CHEM Study) for average to talented students	____	____	____
____	Better total curricula for lower achieving students	____	____	____
____	Better curriculum modules (short, specific, self-contained instructional packages) for average to talented students	____	____	____
____	Better curriculum modules for lower achieving students	____	____	____
	AREA II: INSTRUCTOR PREPARATION			
____	Better pre-service subject matter training	____	____	____
____	Better pre-service methods training	____	____	____
____	Better in-service subject matter training	____	____	____
____	Better in-service methods training	____	____	____
	AREA III: ANCILLARY SUPPORT			
____	Better support to school guidance staffs (e.g., re: technical occupational opportunities, women and minorities in science)	____	____	____
____	Better opportunities for extracurricular student activities (e.g., science fairs, summer programs)	____	____	____
____	Development of better laboratory materials, equipment, and apparatus for instructional use	____	____	____
____	Development of better evaluation and assessment mechanisms	____	____	____

(please turn page)

Rank		Responsibility: Local District	State	Federal Agency
	AREA IV: INNOVATIVE PROJECTS			
____	Better computer based instructional systems	____	____	____
____	Better/wider opportunities for non-traditional student progress patterns (e.g., college courses/credit for high school seniors)	____	____	____
____	More attention to the social and behavioral sciences (psychology, anthropology, etc.)	____	____	____
____	Better integration of science and mathematics programs with the school's other curricula	____	____	____
	AREA V: INFORMATION			
____	Better dissemination of existing information on curriculum alternatives	____	____	____
____	Better dissemination of existing information on teaching strategies and technologies	____	____	____
____	More research for generation of new knowledge on teaching strategies and technologies	____	____	____
____	More research for generation of new knowledge on learning of science and mathematics	____	____	____

Ranking of Areas by Need

Rank		
____	Area I:	Curriculum Materials
____	Area II:	Instructor Preparation
____	Area III:	Ancillary Support
____	Area IV:	Innovative Projects
____	Area V:	Information

SCHOOL ______________________ IDENTIFICATION NO. ____________

A PRINCIPAL'S PERSPECTIVE

The items on front and back of this sheet measure several aspects of your home school environment and your perceptions of the proper emphases for secondary education during the next decade.

Below are ten proposed functions for secondary education.

Please indicate for each function the importance you feel it should have in educational planning. Use the following numbers:

1 = very important, a must   2 = important   3 = less important
4 = still less important   5 = should not be the concern of the school

Please rate no more than three functions as very important ("1"). You may rate only one or two functions as very important if you wish and you may rate as many of the remaining functions 2, 3, 4, or 5, as you feel appropriate.

After rating the functions by importance, please indicate how well you feel each is currently being met at your school. Use the numbers:

1 = well met   2 = adequately met   3 = poorly met

Ten Proposed Functions-Secondary Education

	Importance Rating	Current Performance
1. Providing for student self-realization and self-acceptance	____	____
2. Human (interpersonal) relations education	____	____
3. Providing for student mastery of basic skills in using words and numbers	____	____
4. Citizenship education	____	____
5. Training in practical skills (e.g., money management, driving)	____	____
6. Health education (physical and emotional)	____	____
7. Providing opportunities for student creativity	____	____
8. Vocational education including pre-college counseling	____	____
9. General education (sciences, arts, humanities)	____	____
10. Providing students with information processing and decision making skills	____	____

Which three of these functions do you feel should be the main foci

of science education? ____ ____ ____

of mathematics education? ____ ____ ____

Please estimate the number of each of the following located within two hours' drive of your school.

Permanent institutions with science or math curriculum specialists (colleges, universities, research institutes, etc.) ____

Temporary activities this year (75-76) featuring science or math curriculum specialists, not held at the institutions counted above (conventions, in-service training, workshops, etc.) ____

Other school districts ____

Assuming a major curriculum change had been deemed desirable, please evaluate the capacity, on an average over the past five years, that your building would have had for receiving the change along the following dimensions. Use the scale 1-5 with:

1 = low capacity, many inhibitors; 5 = high capacity, few inhibitors

Physical plant (room size, utilities, storage space, etc.)	1 2 3 4 5	Faculty	1 2 3 4 5
Administrative structure (class grouping, contractual obligations, state curricula, etc.)	1 2 3 4 5	Students	1 2 3 4 5
Financial resources	1 2 3 4 5	Community support	1 2 3 4 5

Following are several means by which members of your building staff may have come in contact with one of the NSF supported texts or programs listed on the Text Usage Form (orange) given you at this meeting. Please estimate the number of different people from your building who have come in contact with any of the programs by each of the following means.

Short workshops (4 days or less) ____ Professional literature ____

Professional association meetings ____ Access to texts and materials ____

College training programs ____

Please indicate your degree of agreement with each of the following statements. Use the scale 1-5 with:

1 = strongly agree 5 = strongly disagree

At my school:

the science and mathematics departments work closely with each other to interlock and correlate their respective programs. 1 2 3 4 5

most science and math courses have explicit, well-defined objectives which serve as the basis for planning instruction. 1 2 3 4 5

all science and math curricula taught are subjected to pre-planned review and evaluation at regular intervals. 1 2 3 4 5